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(54) Self-erecting crane with telescopic and foldable tower

(57) A tower crane with a self-assembling structure and a foldable and extractable tower having portions (14,15) hinged together at horizontal hinges (12,13), wherein a load arm (17) consists of at least one hinged portion (at 13), the tower (14,15) being hinged at a lower end to a bearing structure (10) with a rotation thrust block (19), at least one third portion (16) slotted into and capable of being extracted from one of the hinged portions (14,15) of tower, wherein the third top portion (16) has a smaller section with respect to the portion of tower (15) in which it slides through the collaboration of guide rollers (26,27) arranged both on the portion of tower (15) and on at least one top part (16), with an actuator (30) arranged to act between a support (42) arranged integral inside said hinged portion of tower (15) and a beam (41) integral with a lower end of said top portion (16).

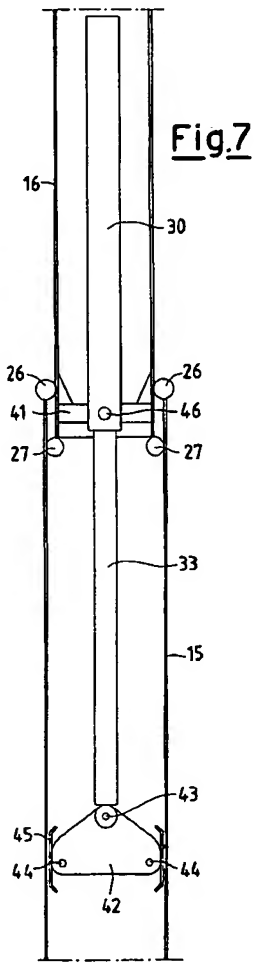

Fig.7

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Description

[0001] The present invention refers to a tower crane with a composite structure and a foldable and successively extractable tower.

[0002] Self-assembling composite structure tower cranes in which the vertical element, known as the tower, consists of a pair of structural portions hinged together are known. Said portions, with the crane folded away, are horizontal and compacted, one on top of the other, whereas, with the crane assembled, they are vertical and aligned with each other to define the tower of the crane.

[0003] There are various structural systems to pass from the position where the crane is dismounted, with folded and horizontal portions of tower, to the position where the crane is assembled, with aligned and vertical portions of tower. The maximum attainable height from the upper end of the tower, and therefore from the arm of the crane connected to said end, is, however, equal to the maximum length of the two portions of tower hinged together.

[0004] It is clear that all of this constitutes a limit to the possibility of use of the crane thus constructed since the possibility of reaching heights above the sum of the lengths of the two portions of tower does not exist. At the same time in known cranes the support of the arm in the engaged position, which when the crane is dismounted is rested above the pair of folded tower portions, is carried out in the alignment and straightening steps of the tower through a suitable combination of rafters and tie rods; this determines substantial bending strains in the two portions of tower and in the various types of organ which can be used to assemble the tower.

[0005] The purpose of the present invention is that of realising a self-assembling composite structure tower crane with the tower realised in at least one pair of portions hinged together and a third portion slotted into the upper portion of the hinged pair capable of being extracted so that the upper end of the tower thus realised can reach a greater height than the height which can be reached with the single pair of hinged portions.

[0006] Moreover, another purpose of the present invention is that of realising a self-assembling crane in which the bending stresses in the two hinged portions of tower and in the members used for the assembly of the tower are reduced to a minimum.

[0007] These purposes according to the present invention are achieved by realising a self-assembling composite structure tower crane according to claim 1.

[0008] Further characteristics of the crane of the invention are outlined in the dependent claims.

[0009] The structural and functional characteristics and the advantages of a self-assembling crane according to the present invention shall become clearer from the description given as an example and not for limiting purposes referring to the attached schematic drawings in which:

figures from 1 to 5 are schematic views of the self-assembling crane according to the invention in a completely folded position, a partially assembled position, with the two portions of tower aligned and the third portion completely slotted in, with the two portions of tower aligned and the third portion partially extracted and totally assembled with the third portion of tower completely extracted,

figures 6 and 7 are schematic views of a possible embodiment of the extraction mechanism of the third portion of tower according to the invention.

[0010] Figures from 1 to 5 show a self-assembling composite structure tower crane according to the invention which has the two portions hinged together at horizontal hinges indicated with 11, 12 and 13. It is made up of a tower consisting of two portions 14 and 15, hinged together at 12, and of a third portion 16 slotted into and capable of being extracted from the upper portion 15 of the two hinged portions; the load arm 17 is made up of one or more sections hinged together and is connected through the hinge 13 to the upper end of the extractable portion of the tower 16.

[0011] The lower portion of the tower 14 is in turn hinged at 11 at its lower end to a *per se* known base structure, wholly indicated with 20, equipped with a rotating base 19. Such a base structure 20 usually foresees means for controlling the unfolding and folding of the entire crane, not specifically indicated, which act through flexible tie rods 21 and 22 which extend laterally to the tower, essentially from the side opposing the load arm and lateral to at least one portion thereof.

[0012] The tie rods form, together with portions of the base structure and with portions of the crane structure, a *per se* known articulated quadrilateral.

[0013] The two hinged portions of the tower 14 and 15 pass from the horizontal position on top of one another, represented in figure 1, to the vertical and aligned position, represented in figure 3, passing through a series of intermediate positions, one of which is represented in figure 2. The control devices which determine the erection and the alignment of the two hinged portions of tower are of the known type.

[0014] When the two hinged portions of tower 14 and 15 are vertical and aligned, as indicated in figure 3, the portion of tower 16 is completely slotted into the portion of tower 15; the load arm 17, hinged at 13 to the upper end of the portion of tower 16, is arranged vertically and rested upon the portions 14 and 15 of the tower. The tie rods 21 and 22 are stretched and hinged together and to the cusp 23, said cusp 23 being in turn hinged to the upper end of the portion of tower 16; the tie rod 21 rests upon the pulley 24 arranged at the end of a further cusp 25 rigidly connected to the upper end of the portion of tower 16.

[0015] In the final assembly step of the tower of the crane the portion of tower 16 is extracted from the hinged portion of tower 15, as indicated in figure 4 and

the control devices of such an extraction shall be illustrated later on. Extracting the portion of tower 16 the traction induced by the tie rods 21 and 22 makes the load arm 17 rotate about the hinge 13 , said load arm 17 hoisting itself up until it reaches the horizontal position, indicated in figure 5, when the portion of crane 16 is completely extracted from the portion of tower 15; conventional devices ensure the locking of the portion of tower 16 in the maximum extraction position in which the crane can be used for carrying loads. *Per se* known devices finally determine the alignment of the possible portions of the arm 17 in the final assembly configuration, indicated in figure 5. A possible embodiment of the control device for the extraction according to the present invention is described hereafter as a non-limiting example with reference to figures 6-7.

[0016] According to the possible embodiment illustrated in figures 6 and 7 the portion of tower with a lower section 16 is slotted into the portion of tower with a greater section 15 and has the possibility of sliding inside of it through guide rollers 26 arranged at the upper end of the portion of tower 15 and through guide rollers 27 arranged at the lower end of the portion of tower 16.

[0017] An actuator, such as a single-acting or double-acting hydraulic cylinder 30, is arranged inside the portion of tower with a smaller section 16; the lower end of the body or barrel of the cylinder is connected through a hinge 46 to a beam 41 integral with the lower end of the portion of tower 16.

[0018] The end of a rod 33 of the hydraulic cylinder 30 is hinged at 43 to a support 42; the support 42 is integrally fixed to the portion of tower with a larger section 15 through two hinge bindings 44. When the rod 33 is fully inserted into the hydraulic cylinder 30 the portion of tower with a smaller section 16 is completely slotted inside the tower with a larger section 15. Extracting the rod 33 of the hydraulic cylinder 30 the push exerted by the cylinder makes the portion of tower 16 slide inside the portion of tower 15 through guide rollers 26 and 27. Once the maximum extraction position of the rod 33 is reached the portion of tower 16 is extracted from the portion of tower 15 by a length equal to the stroke made by the rod 33; in such a position the portion of tower 16 is bound to the portion of tower 15 through conventional locking systems, which are not shown.

[0019] However, to carry out the return, into the slotted in position, of the third portion of tower 16 into the portion of tower 15 in the case of a double acting cylinder 30, the rod 33 is taken back into the hydraulic cylinder; in the case of a single acting piston, when the valve for the inflow or outflow of the oil into/from the cylinder chamber is ordered to open, given the vertical position of the tower in which the extraction and re-entry operations are carried out, it is the weight itself of the overlying structure which makes the rod 33 re-enter determining the ordered re-entry of the portion of tower 16 into the portion of tower 15.

[0020] To ease the assembly of the crane in the construction step the support 42 is equipped on the side with runners 45 which favour the sliding of the group consisting of portion of tower 16-cylinder with inserted rod-support 42, already assembled in part, before such a group is slotted into the portion of tower 15.

[0021] Therefore, one can understand what are the advantages of the crane of the present invention.

[0022] Indeed, this crane has a greater constructive simplicity which makes the construction and the assembly of the entire machine easier.

[0023] Moreover, it has greater safety in use deriving from the elimination of previously known sheaves and cables, which could be subject to slipping off the pulley.

[0024] Yet another advantage is derived from the positioning of the hinge 46 at the lower end of the cylinder 30 which reduces the free length of inflection and therefore reduces the tip load at the pushing step.

[0025] Also, it must not be overlooked that the adoption of a single-acting cylinder, whilst still assuring the functionality in the extraction and re-entry step of the tower, allows the size of the hydraulic cylinder to be substantially reduced.

Claims

1. Tower crane with a self-assembling composite structure and a foldable and extractable tower having portions of tower (14, 15) hinged together at horizontal hinges (12, 13), wherein a load arm (17) consists of at least one hinged portion (at 13), said portions of tower (14, 15) being in turn hinged at a lower end to a bearing structure (10) with a rotation thrust block (19), moreover, foreseeing at least one third portion (16) slotted into and capable of being extracted from one of the hinged portions (14, 15) associated with said portions of tower, said tower being equipped with control devices which allow the assembly into the vertical position and the disassembly into the horizontal position of the two hinged portions of tower and of devices which allow the extraction and the reinsertion of the third portion of tower in one of the portions of tower of the hinged pair, **characterised in that** said third top portion (16) slotted in and capable of being extracted is slidably arranged in one (15) of the two hinged portions and has a smaller section with respect to said portion of tower (15) in which it slides through the collaboration of guide rollers (26, 27) arranged both on said portion of tower (15) and on said at least one top part (16), with an actuator (30) being foreseen arranged to act between a support (42) arranged integral inside said hinged portion of tower (15) and a beam (41) integral with a lower end of said top portion (16).

2. Tower crane according to claim 1, **characterised in that** said support (42) is fixed to said at least one

top portion (16) through hinge bindings (44).

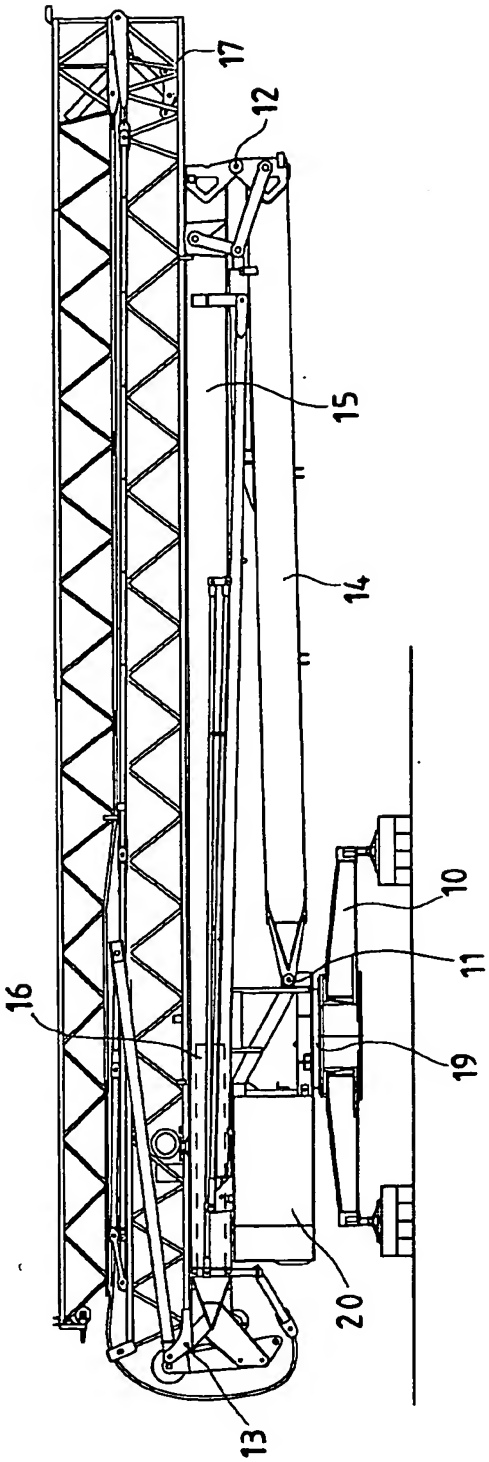
3. Tower crane according to claim 2, **characterised in that** between said support (42) and said at least one top portion (16) runners (45) are arranged which favour the sliding of the group consisting of portion of tower (16), actuator (30) and support (42), already assembled in part, before such a group is inserted in said portion of tower (15).

4. Tower crane according to claim 1, **characterised in that** said actuator (30) consists of a single-acting hydraulic cylinder.

5. Tower crane according to claim 1, **characterised in that** said actuator (30) consists of a dual-action hydraulic cylinder.

6. Tower crane according to claim 1, **characterised in that** said actuator (30) is hinged (at 46) to said beam (41) integral with a lower end of said top portion (16).

Fig.1



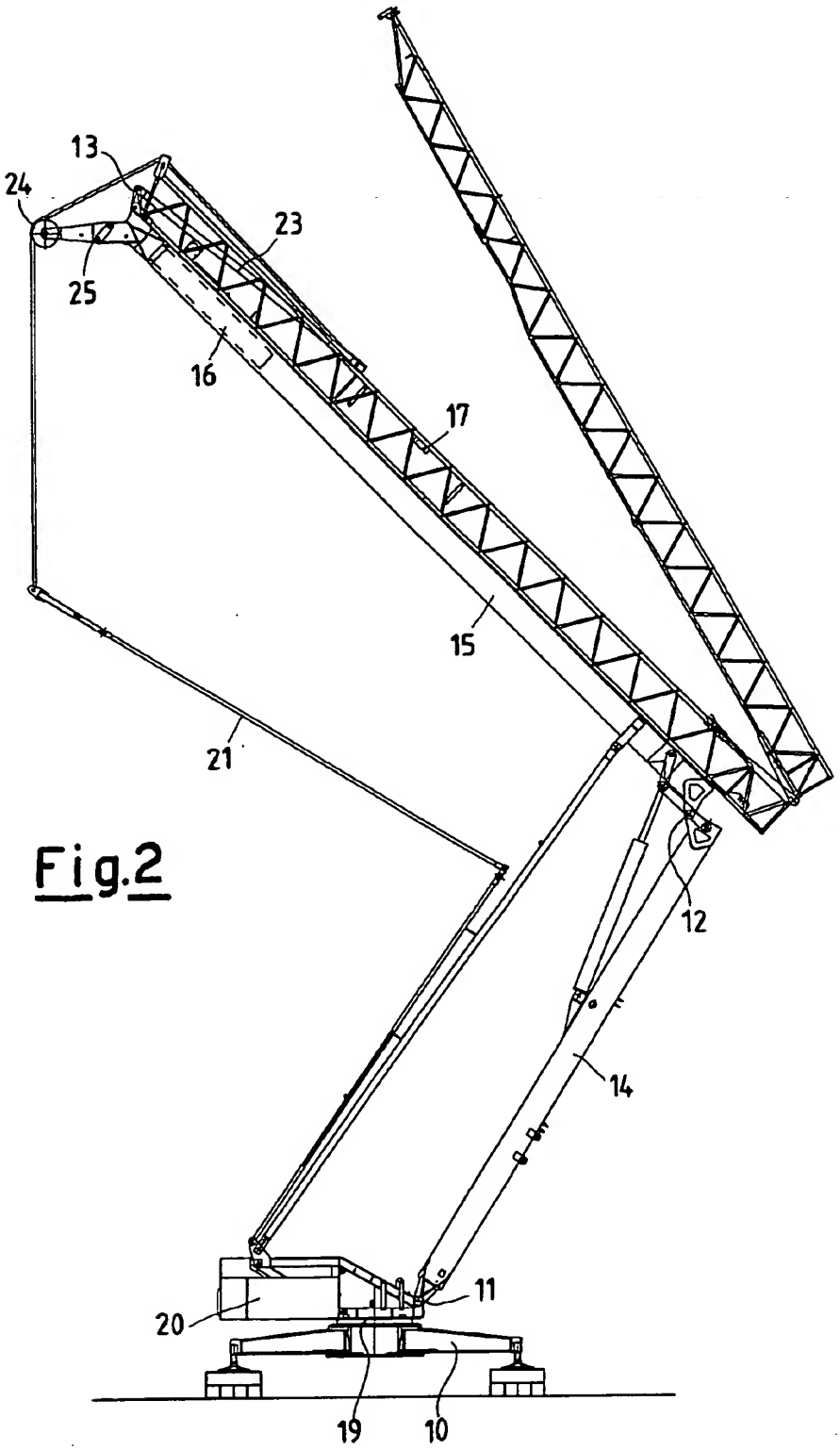
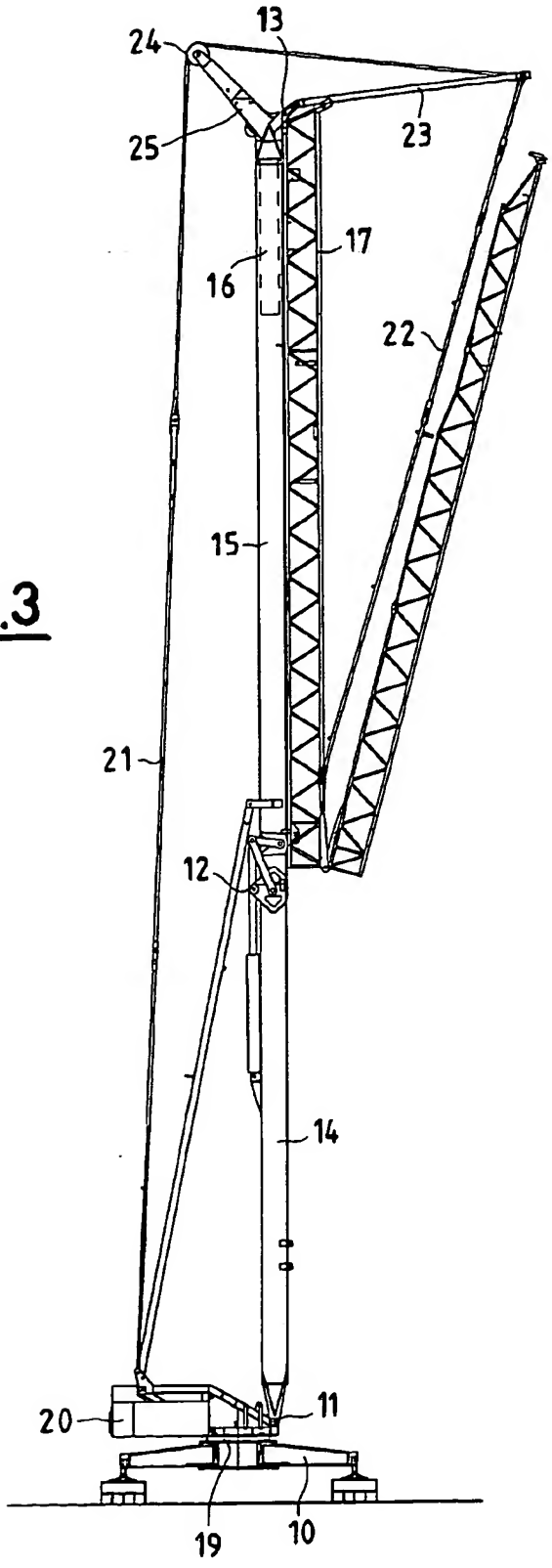


Fig.2

Fig.3



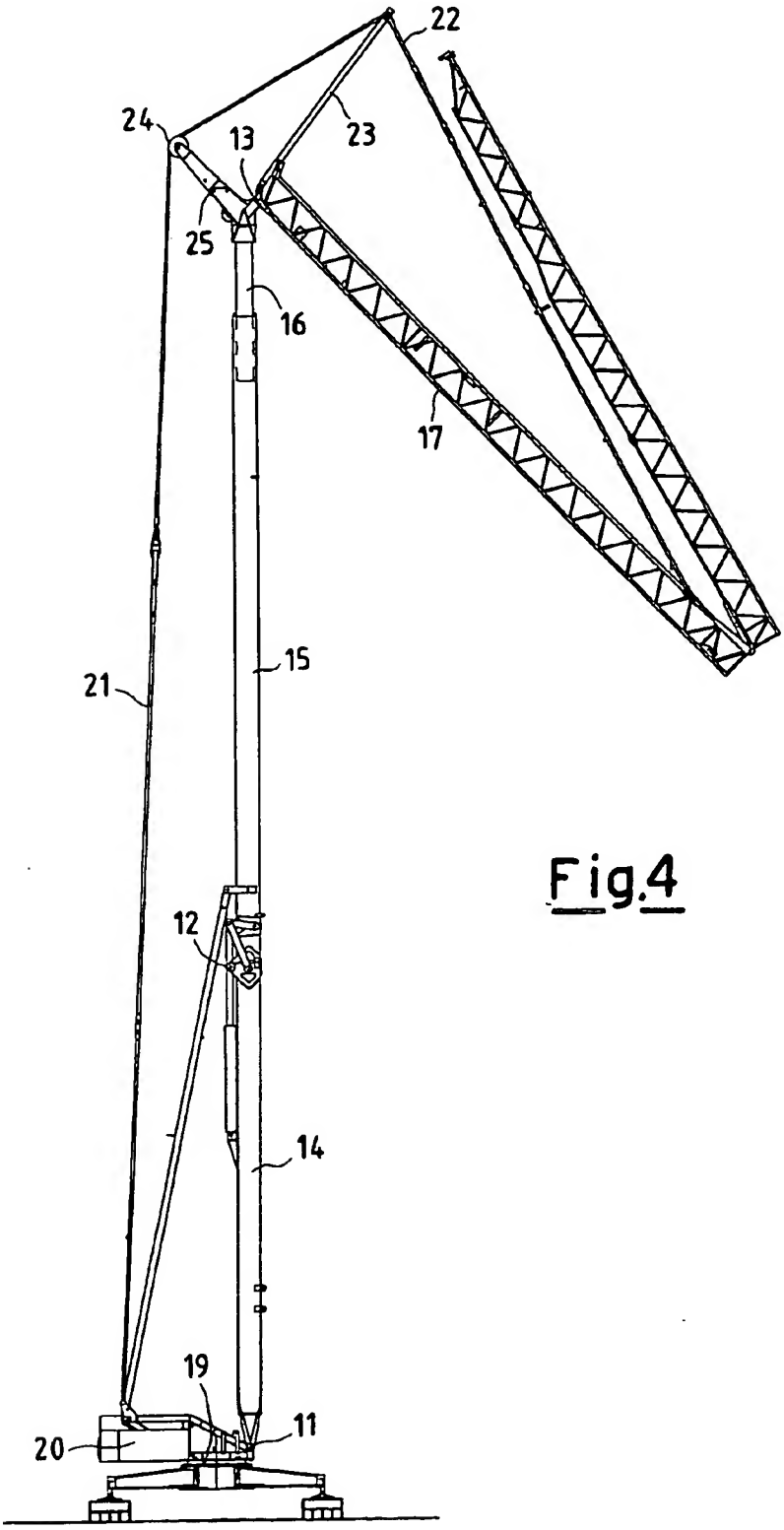


Fig.4

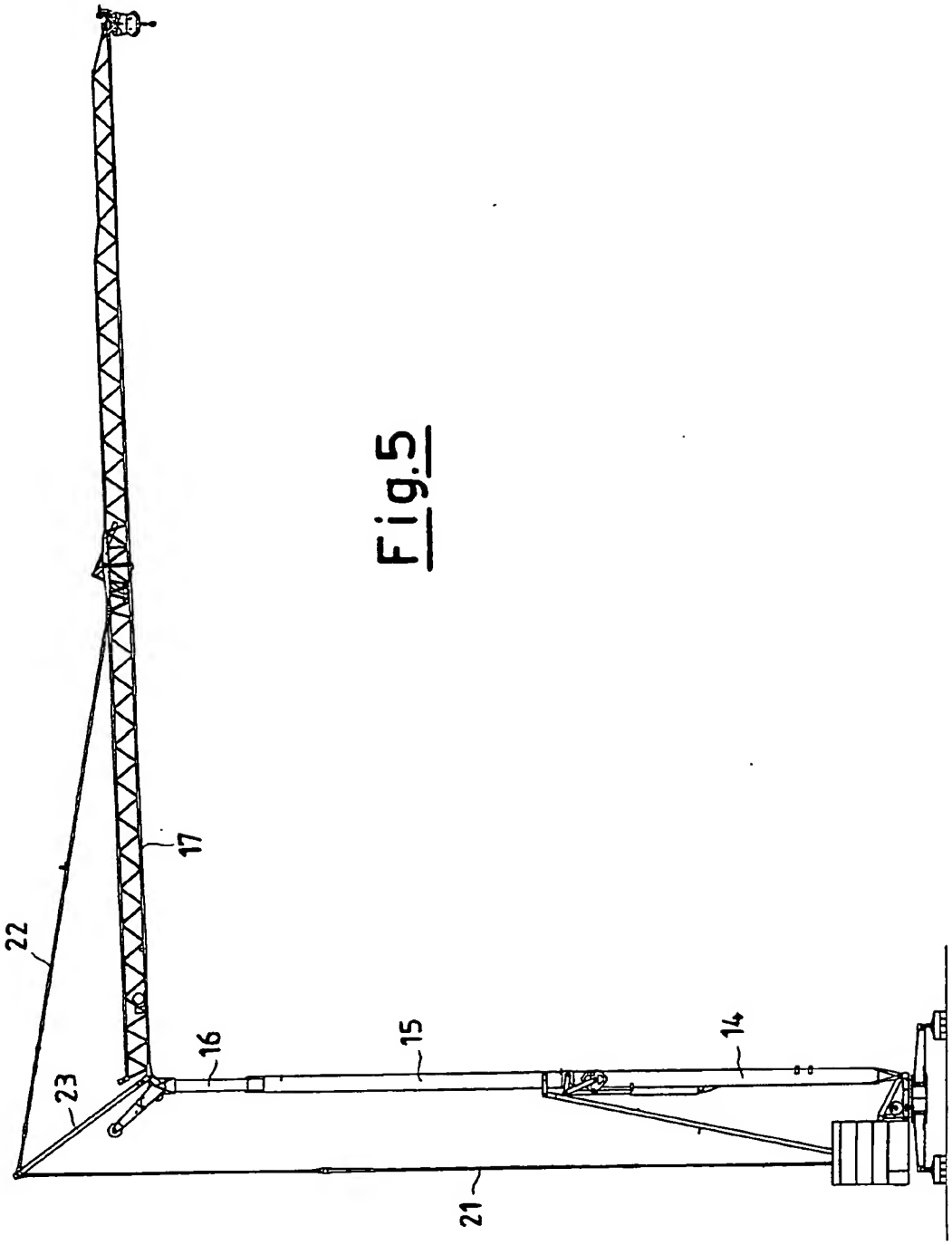


Fig.5

Fig.6

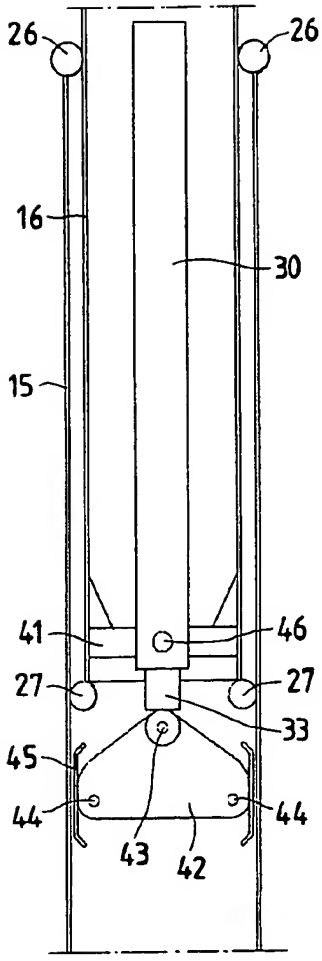

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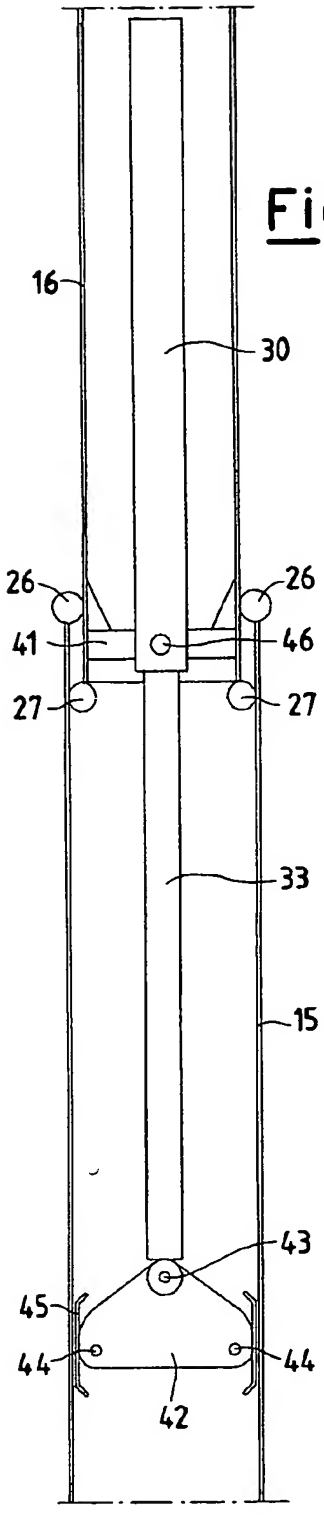
Fig.7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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 4746

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	FR 1 434 262 A (RICHIER SA) 8 April 1966 (1966-04-08) * the whole document *	1	B66C23/34
A	DE 17 56 141 A (MASCHINENFABRIK LANGENFELD GMBH) 20 August 1970 (1970-08-20) * the whole document *	1	
A	GB 971 103 A (ROGER BENOIT CADILLON) 30 September 1964 (1964-09-30) * page 2, line 29 - line 111 * * figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 March 2002	Sheppard, B

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